New Optical Methods For the Study of the Cell: Applications in Pathology

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The analysis of micro-microgram (10^{-12} gm.) quantities of certain biochemical compounds, such as cyclic amino acids, purines and pyrimidines, nucleic acids, porphyrins and steroids, can be performed by instrumentation which employs the reflecting microscope and accessory optical and electronic components. Microabsorption analysis can provide qualitative, identifying information, such as the presence of absorption bands at 416.0, 538.7, and 574.4 $m\mu$ for the oxyhemoglobin contained within a single red blood cell, and quantitative data, such as the amount of hemoglobin in a single red blood cell, 30×10^{-12} gm. or the desoxyribose nucleic acid content of a single cell nucleus, a value of the order of 6×10^{-12} gm.

Problems of interest in pathology which are currently studied in our laboratory by the microspectroscopy of cells include:

1. The maturation of the red blood cell and the accompanying alterations in the nucleic acids and the synthesis of hemoglobin.
2. The localization of the iron-protein complexes, ferritin and hemosiderin.
3. The composition of renal tubular casts in cholemic and hemoglobinuric nephrosis.
4. The localization of fluorescent carcinogens.
5. The nucleic acid content of the normal and the neoplastic cell.
6. The activity of oxidative enzymes in the mitochondria of living cells.

DISCUSSION

MARY A. MARCUS: Is there any evidence that one can identify viruses by this means?

THOMAS G. MORRIONE: Dr. Mellors, what is the degree of accuracy of these quantitative methods?

ALFRED ANGRIST: Can the system be adapted to a fluorescent screen?

ROBERT C. MELLORS: A discussion of the identification of viruses is a subject which would take us far afield. Optical methods that we have described here would not be useful in such a study because, in general, viruses are too small to be observed by this type of microscope. The electron microscope, of course, has great applicability in the study of small particles such as viruses.

The question of accuracy can be answered by saying that the micro-method does not have the accuracy of a macro-method. It is most difficult to express this as a per cent figure without much qualification and detail.

The fluorescent screen can be used for the presentation of rapidly scanned spectra or for the conversion of images that are invisible to those which are visible.